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| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 1 of 23 |

Contents

- 1.0 Purpose & Scope
- 2.0 Responsibilities
- 3.0 Definitions
- 4.0 Prerequisites
- 5.0 Precautions
- 6.0 Procedure
- 7.0 Implementation and Training
- 8.0 References
- 9.0 Attachments
- 10.0 Documentation



U.S. Department of Labor
Occupational Safety and Health

1.0 PURPOSE & SCOPE

Purpose: This document sets the policy of the SHSD IH group in adopting, developing and using Assigned Protection Factors (APF) and standardizes the policy for selecting respiratory protective equipment for non-radiological hazards. This process is used in the selection of the adequate respirator type as part of an effective respiratory protection program. This SOP is to be used in conjunction with the BNL Subject Area *Respiratory Protection* <https://sbms.bnl.gov/standard/23/2300t011.htm>.

The program complies with OSHA 29CFR1910.134 (*Respiratory Protection*) and ANSI Z88.2-1992 (*American National Standard for Respiratory Protection*). In this SOP, BNL adopts APF from those sources and the NIOSH Respirator Decision Logic APFs, the ANSI Z88.2-2002 Draft *American National Standard for Respiratory Protection* and the 29CFR1910.134 (*Respiratory Protection, Proposed Standard for 2003*).

This document describes a procedure for selecting the most appropriate respiratory protective device by considering available equipment options and the hazard and severity of airborne non-radiological contaminants present in the workplace. The goal of the procedure is to provide a uniform methodology in selecting equipment to provide protection to workers using the respiratory equipment and to maintain compliance with exposure standards.

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|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 2 of 23 |

Scope: The scope of this SOP is for non-radiological hazards (such as chemical dusts, fumes, mists, and vapors, lead, toxic metals, and asbestos). It is not intended or approved for use in selecting radiological hazards respiratory protective equipment. It is not for assigning radiological assigned protection factors for equipment. This SOP does not cover issuing respiratory protective equipment. Issuance of respiratory protective equipment is governed by Radiological Control Division procedures.

2.0 RESPONSIBILITIES

- 2.1 This program is implemented through the SHSD Industrial Hygiene Group Leader and the *Respiratory Protection Program Administrator (RPPA)*.
- 2.2 Members of the SHSD Industrial Hygiene Group and other BNL organizations, with qualifications meeting Section 7 of this procedure, can use this document in the respirator selection process. It is the responsibility of persons selecting respiratory protective equipment to comply with all provisions in the BNL Respiratory Protection Program and this SOP.
- 2.3 **Hazard Analysis during selection of respirators:** It is the responsibility of persons selecting respiratory protective equipment to:
 - 2.3.1 Use the appropriate personal protective equipment while performing field evaluations of the work process, when needed.
 - 2.3.2 Obtain all required training and qualification for hazards present in areas where field evaluations will be done (such as lead, asbestos, chemicals, or radioactive contamination).
 - 2.3.3 Comply with all work planning and work permit system requirements when entering areas to obtain information to select the correct respiratory protective equipment.
- 2.4 The person using this procedure is responsible to ensure that information they provide on respirator selection is integrated into the work planning documentation for the work being done.

3.0 DEFINITIONS

- 3.1 **Program Administrator:** A person designated by the IH Group Leader or SHSD management to administer this procedure.

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 3 of 23 |

3.2 **Occupational Exposure Limit (OEL):** The lower of ACGIH TLV®, Ceiling, STEL® or OSHA PEL.

3.3 **Qualified Selector:** A person who has demonstrated competency, in accordance with Section 7, to perform this procedure.

3.4 **Respirator Terms:**

- **Air Purifying:** A respirator that removes specific air contaminants by passing ambient air through a air-purifying element (filter, cartridge, canister).
- **Assigned Protection Factor (APF):** The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or class of respirators to properly fitted and trained users. (*Definition from ANSI Z88.2-1992*).
- **Breathing Air, Grade D:** Air supplied in SCBA or airline systems that meets ANSI/CGA G-7.1-1989: Oxygen 19.5-23.5%; Hydrocarbons 5mg/m³; Carbon monoxide 10 ppm, Carbon Dioxide 1000 ppm, and lack of noticeable odor.
- **Continuous flow respirator:** Atmosphere-supplying respirator providing a continuous flow of air to the respiratory inlet covering.
- **Demand Mode:** A negative pressure, atmosphere-supplying respirator that admits air to the face-piece only when a negative pressure is created inside the face-piece by inhalation.
- **Disposable Respirators:** A respirator discarded after the end of use, after excessive resistance or physical damage, or when odor breakthrough or other warning indicators render the respirator unsuitable for further use.
- **Filtering Face-piece:** A particulate respirator with a filter as an integral part of the face-piece or with the entire face-piece composed of the filtering medium.
- **End-of-Service-life indicator:** A system that warns the user of the approach of the end of adequate respiratory protection.
- **HEPA (High Efficiency Particulate air):** A filter capable of removing at least 99.97% mono-dispersed particulates 0.3 micron in diameter. The NIOSH equivalent is N100, R100, and P100.
- **Loose-fitting face-piece:** A respiratory inlet covering that is designed to form only a partial seal with the face or no seal with the face, e.g. hood or helmet.
- **PAPR:** Powered air-supplying respirators.
- **Pressure-demand respirator:** A positive pressure atmosphere-supplying respirator that admits air to the face-piece when the positive pressure is reduced inside the face-piece by inhalation.
- **SAR:** Supplied-air respirator.
- **SCBA:** Self-contained breathing apparatus

| | |
|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 4 of 23 |

- Tight-fitting face-piece: A respiratory inlet covering that is designed to form a complete seal with the face.

3.5 *Chemical Hazard Types*

- Dust: An aerosol consisting of mechanically produced solid particles derived from the breaking up of larger particles. Dusts generally have a larger particle size when compared to fumes.
- Fumes: Solid aerosols formed by condensation of a gas or vapor. Fumes generally have a smaller particle size than dusts.
- Gas: The gaseous phase of matter that normally exists in a gaseous state at room temperature
- Mist: An aerosol composed of liquid particles.
- Vapor: The gaseous phase of matter that normally exists in a liquid or solid state at room temperature.

4.0 PREREQUISITES

- 4.1 **Qualifications:** See Section 7 *Implementation and Training*. Do not perform work using this procedure without meeting that Section's training and qualification requirements.

5.0 PRECAUTIONS

- 5.1 **Personal Protective Equipment (PPE):** The respirator selection process does not in itself expose the selector to any hazard. Personal protective equipment is not required unless needed to enter hazardous areas to observe workplace conditions.
- 5.2 **Hazard Determination:** The respirator selection process does not cause exposure to any chemical, physical, or radiological hazards. The person performing this procedure may conduct hazard assessment in areas where hazards (such as lead, asbestos, chemicals, or radioactive contamination) may be present.
- 5.3 **Work Planning:** All requirements of work permits and work planning system reviews must be met in performing this procedure.

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|---|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 5 of 23 |

- 5.4 **Environmental Impact and Waste Disposal:** This technique does not have adverse impact on the environment. No waste or environmental contamination is generated in this process.

6.0 PROCEDURE

- 6.1 **Determine the airborne concentration:** Measure or calculate the maximum expected workplace concentration of contaminants by measurement by:

- 6.1.1 NIOSH approved integrated sampling methodology,
- 6.1.2 Calibrated direct reading instrumentation, or
- 6.1.3 Calculation of maximum concentration based on use rate and atmospheric conditions.

Follow accepted methodology described in SHSD IH Group SOPs for use of direct reading instrument use and integrated sampling collection, processing (chain of custody) and exposure analysis. Because activities in the work area may vary during the shift and hazard concentrations could change, the monitoring should cover conditions possible throughout a full work shift.

- 6.2 **Selection of respirator style:** Select the appropriate parameters of the respiratory device to be used by considering the hazards of the contaminant and the ability of the respirator to filter, adsorb, or eliminate the hazard from the breathing zone. Selection factors to consider include:

- **Respirator face piece style:** Half face tight fitting, full face tight fitting, hood, or helmet
- **Mode of operation:** Negative pressure or positive pressure
- **Mechanisms of protection:** Air purifying or air supplying
- **Special Provisions or Regulations:** Fire Fighting (NFPA-SCBA), military/police actions (DOE-Avon).

- 6.3 **Consider the physical, environmental, and chemical use conditions at the work area when specifying respirator type and the impact of respirator use on the work, including:**

- Worker activity: Continuous or intermittent work; Light, medium, or heavy work.
- Frequency of use: Routine, non-routine, emergency or rescue use
- Access to the hazardous area, especially impact on the escape of workers if an emergency occurs and access of rescue operations.

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division | | NUMBER IH72200 |
| INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 6 of 23 |

- Respirator characteristics, capabilities, and limitations: especially flow rate; compatibility of facepiece and components with the hazard, impact of environmental conditions on ability to wear equipment (humidity/heat),
- Physical, chemical, and toxicological properties of the contaminant(s): including physical state (gas, vapor, particulate/dust, fume, and mist), including: oxygen deficient atmospheres; atmospheres immediately dangerous to life and health; combination of hazard classes; odor threshold and warning properties; and eye irritant potential.
- The person's ability to wear or use the equipment and negative impact of the equipment on the operation, including: facial hair, vision impairment (need for glasses, reduction in field of view, etc.), and communication ability.

6.4 If an air purifying cartridge or canister is selected:

6.4.1 Check that cartridges are approved for the hazards by checking these sources:

6.4.1.1 A good source of the type of cartridge to select cartridges (based on chemical name) is the Online NIOSH Pocket Guide to *Chemical Hazards* at <http://www.cdc.gov/niosh/npg/npgd0000.html>. A sample of a page from this web site is attached as *Attachment 9.3*.

6.4.1.2 See the ***BNL Recommended Equipment for Specific Hazards*** in *Attachment 9.1* which provides a list of the approved respiratory protection equipment for common BNL hazards by class of hazard.

6.4.1.3 See *Attachment 9.4* for the color code table and product ordering numbers for the two main vendors at BNL.

6.4.2 Determine the **end-of-service life** based on the best available information including from the respirator manufacturer, chemical manufacturer. See Attachment 9.5 for references to manufacturers EOSL calculators.

6.5 Determine the APF from *Attachment 9.2* for the proposed respirator style.

6.6 Confirm that the respirator will provide adequate protection using Formula.6.6. If Formula 6.6 is less than the Occupational Exposure Limit (OEL), then the respirator type and cartridge (if applicable) may be selected.

Formula 6.6 A respirator is acceptable for use when"

$$(\text{Airborne Concentration}) \div (\text{APF}) < (\text{Occupational Exposure Limit})$$

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 7 of 23 |

- 6.7 When multiple contaminants are present, select the equipment based on protection for most hazardous contaminant. However, the selected equipment must also be applicable for all other hazards.

Example 1: if Mercury (OEL= 0.025 mg/m³) is present with Lead (OEL= 0.050 mg/m³), the appropriate APR selection (if airborne concentrations permit) is Mercury (most Hazardous) adsorbent cartridge vapor for Hg. But because the mercury cartridge is not protective of lead, additional HEPA filtration is required, i.e. a combination cartridge.

Example 2: if Mercury (OEL= 0.025 mg/m³), Lead (OEL= 0.050 mg/m³), and Methanol (OEL= 200 ppm) are all present in the atmosphere, the appropriate APR selection (if airborne concentrations permit) is Mercury (most Hazardous) adsorbent cartridge vapor for Hg, HEPA filtration for Lead, and organic vapor cartridge for Methanol. If such a multiple purpose assemble is not available, then air supplied respiratory protection would be needed. Note: OEL are set for single chemical substance exposure. In cases of mixed compounds, you may need to be lower the OEL if there is an additive effect from two or more hazards acting together. The base formula is:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \dots + \frac{C_n}{T_n} \quad \text{sum is not to exceed 1}$$

- 6.8 Document the equipment selection on the *Respirator Selection Form* located in the BNL SBMS subject area *Respiratory Protection* <https://sbms.bnl.gov/standard/23/2303e011.doc>. A sample is listed as Attachment 9.4.

7.0 IMPLEMENTATION AND TRAINING

- 7.1 For SHSD personnel, the IH Group Leader or Respiratory Protection Program Administrator shall qualify persons to use APFs under this program. The qualification criteria for a use of this SOP are:

- 7.1.1 An overall knowledge of respiratory protection principles and completion of the BNL courses (or equivalent) in APR/PAPR and SCBA.
- 7.1.2 Specific knowledge of this procedure, OSHA 29CFR1910.134 and ANSI Z88.2. This can be gained from work experience or specialized training courses.
- 7.1.3 Demonstrated competency in applying APFs in the selection of respiratory protection.
- 7.1.4 The documentation of SHSD personnel qualification is to be made on Attachment 9.5.

- 7.2 For non-SHSD personnel using this SOP, the person's line management shall establish qualification criteria that are compliant with ANSI and OSHA drivers and shall qualify persons to use this SOP.

| | |
|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 8 of 23 |

- 7.2.1 The qualification criteria used should be approved by the RPPA.
- 7.2.2 The documentation of personnel qualification is to be made on an equivalent to Attachment 9.5.

8.0 REFERENCES

- 8.1 Occupational Safety and Health Administration, OSHA 29CFR1910.134 (*Respiratory Protection*)
- 8.2 American National Standard Institute (ANSI) Z88.2. (*American National Standard for Respiratory Protection*).
- 8.3 National Institute for Occupational Safety and Health, *NIOSH Respirator Decision Logic DHHS/NIOSH Publication No. 97-108*.

9.0 ATTACHMENTS

- 9.1 **Attachment 9.1:** *BNL Recommended Equipment for Specific Hazards*
- 9.2 **Attachment 9.2:** *BNL Adopted Assigned Protection Factors (APF) for Non-Radiological Hazards*
- 9.3 **Attachment 9.3:** *Sample of Online NIOSH Pocket Guide to Chemical Hazards*
- 9.4 **Attachment 9.4:** *NIOSH Classifications for Respiratory Protection Equipment*
- 9.5 **Attachment 9.5:** *End-of-Service Life Calculations*
- 9.6 **Attachment 9.6:** *Sample of SBMS Respiratory Protection: Respirator Selection Form*
- 9.7 **Attachment 9.7:** *SHSD Non-Radiological Respirator Qualification record*

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 9 of 23 |

10.0 DOCUMENTATION

| Document Review Tracking Sheet | | |
|--|---|--|
| Prepared By: <i>(signature/date on file)</i> R. Selvey 04/04/02 Certified Industrial Hygienist | Reviewed By / Date: <i>(signature/date on file)</i> N. Bernholc 04/26/02 Certified Industrial Hygienist | Approved By / Date: <i>(signature/date on file)</i> R. Selvey 05/13/02 Industrial Hygienist Group Leader |
| RCD Review Comments received and incorporated from: P. Burke, J. Durnan, C. Weilandics | | |
| Filing Code: IH52QR.01 | QA Review / Date: | Effective Date: 05/13/02 |

| Periodic Review Record (3 year cycle) | | |
|---------------------------------------|---|--|
| Date of Review | Reviewer Signature and Date | Comments Attached |
| 11/05/03 | <i>(signature/date on file)</i> Robert Selvey 11/05/03 | Revised APFs for agreement with RCD SOP-4002 and to reflect the OSHA proposed APFs. |
| 4/15/04 | <i>(signature/date on file)</i> Robert Selvey 4/15/04 | Add Qualification specifications in Attachment 9.5. |
| 07/09/04 | <i>(signature/date on file)</i> Robert Selvey 7/09/04 | Add new definitions. Added text in 6.7 on additive OELs. Attachment 9.1 revised to add more particulates. Added Attachments 9.4 and 9.5. |
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|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 10 of 23 |

Attachment 9.1

BNL Recommended Equipment for Specific Hazards

| Hazard Type | Example of Hazard | Approved Respirator Type(s) | Limitations |
|---------------------------|---|---|---|
| Paint Spray | Lacquers, Paints | APR, half/full face, Combo- OVC/Paint Cartridge or filter Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus | Not for Paints containing Isocyanates without RPPA approval |
| Pesticides | Dursban® | APR, half/full face, OVC/Pesticide Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus | Not for Fumigants |
| Toxic Dust, Mist, Fumes | Silica, Welding Fumes, Cadmium, Lead, Asbestos, Beryllium, some Biological Agents | APR, half face, dust filter APR, full face, dust filter APR, half face, HEPA filter APR, full face, HEPA filter PAPR, full face, HEPA filter PAPR, helmet, HEPA filter PAPR, hood, HEPA filter Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus | |
| Organic Vapor/Gas | Acetone, Isopropanol | APR, half face, OVC APR, full face, OVC APR, half face, Acid Gas/OVC APR, full face, Acid Gas/OVC Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus | |
| Acid Gases | Chlorine, Sulfur Dioxide Hydrogen Chloride | APR, half face, Acid Gas/OVC APR, full face, Acid Gas/OVC Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus | |
| Special Hazard Gas/Vapors | Ammonia, Mercury, Formaldehyde | APR, half/full face, Ammonia, Formaldehyde, Mercury cartridges (Special Order) Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus | |
| Asphyxiants | Nitrogen, Helium | Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus Escape device, 5 minute compressed air Escape Device, 10 minute compressed air | Oxygen levels less than 19.5% |

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | | DATE 07/09/04 |
| | | PAGE 11 of 23 |

Attachment 9.2

IH Group Adopted Assigned Protection Factors (APF) for Non-Radiological Hazards (2nd Column of Table)

| Respirator Type | SHSD IHG IH72200 Rev 1 Adopted APF | References for SHSD APF Selection | | | | |
|--|---|-----------------------------------|---|-------|------------------------|---------------------------------|
| | | RCD FS-SOP- 4002 Rev. 3 | OSHA 29CFR1910 .134 (Proposed) | NIOSH | ANSI Z88.2- 1992 | ANSI Z88.2- 2002 DRAFT |
| Half mask Air Purifying Respirator (APR) ⁽²⁾ (Negative Pressure) | 10 | 10 | 10 | 10 | 10 | 10 |
| Full-Facepiece APR (Negative Pressure) | 50 | 100 | 50 | 50 | 100 | 10 |
| Loose-fitting facepiece Powered Air Purifying (PAPR) (Positive Pressure) | 25 | 25 | 25 | | | 25 |
| Half mask PAPR (Positive Pressure) | 50 | 50 | 50 | 50 | 50 | 50 |
| Full-Facepiece PAPR ⁽³⁾ (Positive Pressure) | 1000 | 1,000 | 1000 | 50 | 1000 | 1000 |
| Helmet / Hood PAPR ⁽³⁾ (Positive Pressure) | 1000 | 1,000 | 1000 | | | [1000] |
| Half mask Atmosphere Supplying Airline (ASA) ⁽²⁾ (Demand) | 10 | 10 | 10 | | | |
| Full Mask ASA (Continuous Flow) | 50 | | 50 | | | |
| Loose-fitting facepiece ASA (Continuous Flow) | 25 | 25 | 25 | | | |
| Half mask ASA ⁽²⁾ (Continuous Flow) | 50 | 50 | 50 | | | 250 |
| Full facepiece ASA (Demand) | 50 | 100 | 50 | 100 | | |
| Full facepiece ASA (Pressure Demand or Continuous Flow) | 1000 | 1,000 | 1000 | | | 1000 |
| Helmet / Hood ASA (Continuous Flow) | 1000 | 1,000 | 1000 | 1000 | | |
| Military Mask- Avon F12 (Negative Pressure) | 50 | | | 50 | | |
| Half mask Self Contained Breathing Apparatus (SCBA) ⁽²⁾ (Demand) ⁽⁴⁾ | 10 | 10 | 10 | | | |
| Full facepiece SCBA (Demand) ⁽⁴⁾ | 50 | 100 | 50 | | | |

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 12 of 23 |

| Respirator Type | SHSD IHG IH72200 Rev 1 Adopted APF | References for SHSD APF Selection | | | | |
|--|---|-----------------------------------|---|--------|------------------------|---------------------------------|
| | | RCD FS-SOP- 4002 Rev. 3 | OSHA 29CFR1910 .134 (Proposed) | NIOSH | ANSI Z88.2- 1992 | ANSI Z88.2- 2002 DRAFT |
| Full facepiece SCBA (Pressure Demand Open/Closed Circuit) | 10,000 | 10,000 | | 10,000 | 10,000 | 10,000 |
| Helmet Hood SCBA (Demand) | 50 | | 50 | | | |

- (1) Assigned Protection Factor per ANSI Z88.2-1992
- (2) Includes 1/4 mask, disposable half mask and half mask with elastomeric facepieces.
- (3) Listed APF are for high-efficiency filters and sorbents (cartridges and canisters). With dust filters, an assigned protection factor of 100 is to be used due to the limitations of the filter.
- (4) Demand SCBA **shall not** be used for emergency situations such as fire fighting

NOTE: Assigned protection factors are not applicable for escape respirators. For combination respirators, e.g. airline respirators equipped with an air-purifying filter, the mode of operation in use will dictate the assigned protection factor to be applied.

| | | |
|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | | REVISION FINAL rev3 |
| | | DATE 07/09/04 |
| | | PAGE 13 of 23 |

Attachment 9.3

Sample of Online NIOSH Pocket Guide to Chemical Hazards

NIOSH Pocket Guide to Chemical Hazards

| | | |
|---|---|--|
| Acetic acid | | CAS 64-19-7 |
| CH ₃ COOH | | RTECS AF1225000 |
| Synonyms & Trade Names Acetic acid (aqueous), Ethanoic acid, Glacial acetic acid (pure compound), Methanecarboxylic acid [Note: Can be found in concentrations of 5-8% in vinegar.] | | DOT ID & Guide 2790 153 (10-80% acid) 2789 132 (>80% acid) |
| Exposure Limits | NIOSH REL: TWA 10 ppm (25 mg/m ³) ST 15 ppm (37 mg/m ³) | |
| | OSHA PEL: TWA 10 ppm (25 mg/m ³) | |
| IDLH 50 ppm See: 64197 | | Conversion 1 ppm = 2.46 mg/m ³ |
| Physical Description Colorless liquid or crystals with a sour, vinegar-like odor. [Note: Pure compound is a solid below 62°F. Often used in an aqueous solution.] | | |
| MW: 60.1 | BP: 244°F | FRZ: 62°F |
| VP: 11 mmHg | IP: 10.66 eV | Sp.Gr: 1.05 |
| FLP: 103°F | UFL: 2000°F | LP: 4.8% |
| Class II Combustible Liquid: F | | Corrosive to |
| Incompatibilities & Reactivity Strong oxidizers (especially chlorates and peroxides), metals.] | | |
| SAMPLE | | |
| Measurement Methods NIOSH 1603 ; OSHA ID186SG See: NMAM or OSHA Methods | | |
| Personal Protection & Sanitation Skin: Prevent skin contact (>10%) Eyes: Prevent eye contact | | First Aid (See procedures) Eye: Irrigate immediately Skin: Water flush immediately |

| | | |
|---|-------------------------|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division | | NUMBER IH72200 |
| INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 | |
| | PAGE 14 of 23 | |

Wash skin: When contaminated (>10%)
 Remove: When wet or contaminated (>10%)
 Change: No recommendation
 Provide: Eyewash (>5%), Quick drench (>50%)

Breathing: Respiratory support
 Swallow: Medical attention immediately

Respirator Recommendations NIOSH/OSHA

Up to 50 ppm: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode[£]/(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)/(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Escape: (APF = 50) Any air-purifying respirator with organic vapor canister/Any self-contained breathing apparatus (SCBA) with a full facepiece, front- or back-mounted

Exposure Routes inhalation,

Symptoms Irritation eyes, skin, nose, throat, hyperkeratosis; conjunctivitis;

Target Organs Eyes, skin, respiratory system, teeth

See also: [INTRODUCTION](#) See ICSC CARD: [0363](#)

SAMPLE

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|--|--|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 15 of 23 |

Attachment 9.4

NIOSH Classifications for Respiratory Protection Equipment

Filters









| Type | Description |
|--------------|--|
| N95 | Filters at least 95% of airborne particles. Not resistant to oil. |
| N99 | Filters at least 99% of airborne particles. Not resistant to oil. |
| N100 | Filters at least 99.7% of airborne particles. Not resistant to oil. |
| R95 | Filters at least 95% of airborne particles. Somewhat resistant to oil. |
| R99* | Filters at least 99% of airborne particles. Somewhat resistant to oil. |
| R100* | Filters at least 99.7% of airborne particles. Somewhat resistant to oil. |
| P95 | Filters at least 95% of airborne particles. Strongly resistant to oil. |
| P99* | Filters at least 99% of airborne particles. Strongly resistant to oil. |
| P100 | Filters at least 99.7% of airborne particles. Strongly resistant to oil. |

* No NIOSH approvals are held by this type of disposable particulate respirator.

Adsorbents

| | | | |
|---|-------|--|----------------------------------|
| 42 CFR 84.190 Chemical cartridge respirators: description. Type of chemical cartridge respirator ¹ Maximum use concentration, parts per million | | MSHA/NIOSH have certified respirators for use against: (Reference: FR 49 No. 140, pages 29270-29272, July 19, 1984). | |
| | | <u>Gas/Vapor</u> | <u>Maximum Use Concentration</u> |
| Ammonia..... | 300 | Mercury* | 0.5 mg/m3 |
| Chlorine..... | 10 | Hydrogen sulfide* | 100 parts per million |
| Hydrogen chloride..... | 50 | Chlorine dioxide | 1 part per million |
| Methyl amine..... | 100 | Formaldehyde | 30 parts per million |
| Organic vapor..... ² | 1,000 | | |
| Sulfur dioxide..... | 50 | | |
| Vinyl chloride..... | 10 | | |
| ¹ Not for use against gases or vapors with poor warning properties (except where MSHA or Occupational Safety and Health Administration standards may permit such use for a specific gas or vapor) or those which generate high heats of reaction with sorbent material in the cartridge. | | *Respirators may be certified for gases and vapors with poor warning properties if there is a regulatory agency standard which permits their use and an effective end-of-service-life indicator is provided. | |
| ² Maximum use concentrations are lower for organic vapors which produce atmospheres immediately hazardous to life or health at concentrations equal to or lower than this concentration. | | | |

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| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| | DATE 07/09/04 PAGE 16 of 23 |

| <i>Protected Against</i> | <i>Colors Assigned</i> |
|---|--|
| Multipurpose <i>North 75SC: Defender Multi-Purpose Cartridge for Organic Vapor, Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Sulfide (Escape), Hydrogen Fluoride, Chlorine Dioxide, Ammonia, Methylamine and Formaldehyde.</i> | Olive  |
| Acid gases <i>North N75002: Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Fluoride, Chlorine Dioxide, Formaldehyde Cartridge</i> <i>North RT21 Hydrogen Chloride, Hydrogen Fluoride, Sulfur Dioxide and Hydrogen Sulfide Cartridge with Real-Time ESLI (End-of-Service-Life Indicator)</i> | White.  |
| Mercury <i>North N750052</i> | Orange with indicator stripe  |
| Organic vapor <i>North N75001</i> | Black  |
| Ammonia, Methylamine Cartridge <i>North 75004</i> <i>North RT41 (with indicator strip)</i> | Green  |
| Acid gas and organic vapors <i>North N75003: Organic Vapor, Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Fluoride, Chlorine Dioxide Cartridge</i> <i>North RT11 Organic Vapor Cartridge with Real-Time ESLI (End-of-Service-Life Indicator) for TDI</i> | Yellow  |
| Radioactive materials, excepting tritium and noble gases <i>North 7580P100- Plastic case</i> <i>North 75FFP100- filter body</i> | Purple (Magenta)  |
| N95 Particulate <i>North 7506N95</i> |  |

[illegible]

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|---|-------------------------------|
| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 18 of 23 |

Attachment 9.5

End-of-Service Life Calculations

Occupational Safety and Health Administration (OSHA) does not allow reliance on odor thresholds and other warning properties solely as the basis for changing respirator chemical cartridges. OSHA requires implementing change out schedules for respirator cartridges based on objective data. Respirator manufacturers have developed service-life software for their cartridge respirator users (see links below). Workplace exposures and environmental conditions must first be determined and then entered into the service-life software to calculate breakthrough times. Most service-life software calculators are based on exposure from a single contaminant; however, most workplace exposures are from mixtures of chemicals. Some manufacturers, like 3M (Minnesota Mining and Manufacturing Company) have software that calculates change out schedules for chemical mixtures using OSHA's rules of thumb for computing breakthrough times for mixtures.

Refer to the following references for assistance in determining end of

3M Respirator Service Life Software Version 2.0:

http://www.3m.com/occsafety/frameets/software_solutions.html

MSA Cartridge Life Expectancy Calculator:

<http://www.msanet.com/msanorthamerica/msaunitedstates/cartlife/>

AOSafety "Merlin2.1™" Cartridge Changeout Program

<http://www.aearo.com/html/products/respirat/respfor.htm> for threaded metal cartridges

<http://www.aearo.com/html/products/respirat/resp8000.htm> for bayonet style plastic cartridges

Survivair Cartridge Service Life Software

<http://www.survivair.com/cartlife.html>

North Safety Products

http://www.northsafety.com/feature_ezguide.htm

Willson Respirators (Christian Dalloz)

http://www.christiandalloz.com/CDalloz_Internet/news_events/publicslw.htm

For Willson7 Cartridge Service Life CD ROM call the Dalloz Safety Technical Service Center at 1-800-977-9177

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| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | NUMBER IH72200 |
| | REVISION FINAL rev3 |
| Subject: Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | PAGE 19 of 23 |

Attachment 9.6

Sample of

SBMS Respiratory Protection

Respirator Selection form

(see second page)

| | | |
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| BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Program Procedure | | NUMBER IH72200 |
| | | REVISION FINAL rev3 |
| Subject: | Respiratory Protection Program Policy Respirator Selection for Non-Radiological Hazards | DATE 07/09/04 |
| | | PAGE 20 of 23 |

Attachment 9.7

Sample of

Non-Radiological Respirator Selector SHSD Qualification Record

(see next pages)

RESPIRATOR SELECTION FORM

Issuance #

Project Information

| | | |
|--------------------------------|---|---------------------|
| Work Order #: | Job #: | Activity #: |
| Work Permit #: | RWP #: | Date(s) of Project: |
| Department: | Building: | Room/Area: |
| Scope of Work Contact Name: | Phone: | Pager: |
| Description of Area: | <div style="border: 2px dashed red; padding: 10px; text-align: center;"> <h1 style="color: red;">SAMPLE ONLY</h1> <p style="color: red; font-size: 1.2em;">See SBMS Respiratory Protection Subject Area for most recent version of this form</p> </div> | |
| Description of Work to | | |
| Line Management Appr | | |
| | | |

Hazard Informa

Description of

| | | |
|---|--|--|
| | | ured |
| | | Air Concentration |
| Radiological: Isotope: _____ Particulate _____ Gas _____ | | |
| Chemical _____ Asbestos _____ Lead _____ Mercury _____ Other: _____ | | |
| Biological _____ Animal/Bird Droppings _____ Etiologic Agent _____ Other: _____ | | |
| Regulatory: _____ Voluntary Use _____ Precautionary _____ Nuisance Level _____ Required Use Other: _____ | | _____ <Action Level _____ <PEL/TLV _____ >PEL/TLV _____ >IDLH |
| Hazard analysis: Concentration determined by: _____ Measurement _____ Calculation _____ Analogy to Similar Work | | _____ MSDS Reviewed _____ Tour of Area |
| Hazard Analysis By: <div style="display: flex; justify-content: space-between; margin-top: 10px;"> Print Signature Date </div> | | |

Equipment Selection

| | | | | |
|---|---|---------------------------------|---|------------|
| Facepiece | _____ Full face | _____ Half Face | _____ Hood | Other: |
| Respirator Type | _____ APR | _____ PAPR | _____ Air Line | _____ SCBA |
| Cartridge(s) _____ SINGLE _____ COMBO (Mark all needed elements) | _____ HEPA (Purple) _____ P-100 _____ N100 _____ Particulate _____ N95 _____ P95 _____ R95 _____ N99 _____ Organic Vapor (Black) _____ Organic Vapor/Acid Gas (Yellow) _____ Acid Gas (White) | | _____ Multi-purpose (Olive) _____ Ammonia/Amine (Green) _____ Mercury/Chlorine (Orange) _____ Other: _____ | |
| End of Service on Cartridges | _____ Replace at End of 8 hour Shift | _____ Change via ESL Indicator | Replace after _____ (minutes) (hours) (days) <div style="text-align: center;">circle one</div> | |
| Cartridge Reuse: | _____ Leave on face piece, tape inlet _____ Dispose after 1 use _____ Remove from face piece, store in separate bag | | Cartridge Disposal: | |
| Return of Face piece | _____ Permanent Issue | _____ Destroy/Dispose after use | Return on: | |
| Respirator Equipment Specification Made By: <div style="display: flex; justify-content: space-between; margin-top: 10px;"> Print Signature Date </div> | | | | |

SHSD IH Group Member

Non-Radiological Hazard Respirator Selector Qualification Record

Job Performance Measure (JPM) Completion Certificate

| | | |
|------------------|--------------|-----------------------|
| Candidate's Name | Life Number: | Qualification Number: |
| | | HP-IHP- 72200 |

Practical Skill Evaluation: Demonstration of Evaluation Methodology

| Criteria | | Qualifying Performance Standard | Unsat. | Recov. | Satisf. |
|----------|---|---|--------|--------|---------|
| 1. | Determining the need for selection investigation | Demonstrates knowledge that the selection investigation can be prompted by: worker's concern, line management requests, exposure monitoring data, or observation of other indicators. Includes: <ul style="list-style-type: none"> Engineering Controls and Admin Controls explored for feasibility Voluntary Use versus Mandatory versus Regulatory | | | |
| 2. | Conducts appropriate interviews | Demonstrates knowledge in conducting interviews with supervision and workers to determine exposure characteristics, patterns, and duration. Includes: <ul style="list-style-type: none"> Review of Work Planning & Control documents Health and Safety Plans Standard Operating Procedures, Skill of Craft Documentation/ PPE Matrix Tables | | | |
| 3. | Hazard Identification | Demonstrates knowledge to correctly determine and document the type of airborne hazards, including: Chemical, Biological and (Radiological). Includes: <ul style="list-style-type: none"> Describes the types of health hazards from chemical and biological sources and the appropriate PPE as in Attachment 9.1 Implications of each type hazard on respirator selection Compounding of different hazard types (such as particulates and vapors, biological agents and disinfectants). Mixtures: Synergistic and Additive Effects | | | |
| 4. | Measurement of hazard | Knows how to properly measure employee exposure to hazardous airborne levels of chemical and biological hazards, find existing exposure data, or extrapolate from representative data. | | | |
| 5. | Other Hazards Contribution to exposure | Understands the potential of surface contamination, airborne levels of other contaminants hazards as contributors to total exposure. <ul style="list-style-type: none"> Influence on personnel exposure Influence on equipment and personnel decontamination | | | |
| 6. | Regulatory Compliance | Knows how to appropriately determine the effectiveness of different respirators types to satisfy: <ul style="list-style-type: none"> Permissible Exposure Limits and Threshold Limit Values® Additive OELs calculations The purpose of the Assigned Protection Factor, and where to find APF listings, see Attachment 9.2. | | | |

Continued on page 2

| | Criteria | Qualifying Performance Standard | Unsat. | Recov. | Satisf. |
|-----|---------------------------------|--|--------|--------|---------|
| 7. | Equipment Selection | Knows the theory, advantages, disadvantages, and limitations to consider in selecting the respirators, including: <ul style="list-style-type: none"> • Face Piece- Half face, Full face, Hood, Helmet • Type of air supply- APR, PAPR, Airline, SCBA, etc. • Media: HEPA, Adsorbent, Combination, etc. • NIOSH certification on masks, fittings, cartridges, etc. Knows sources of recommendations for respirator selection, such as the NIOSH Pocket Guide. | | | |
| 8. | Operating Parameters | Knows the theory to establish operating parameters (safety envelope) for the respirator selected: <ul style="list-style-type: none"> • Service Life for supplied air systems • Cartridge End of Service Life • Break-through time • Warning Properties • ODH • SAR testing for CO, Hydrocarbons/Oil, Humidity • SAR number and length of supply hoses • Employee characteristics- facial hair, eyeglasses, physical fitness. | | | |
| 9. | Decontamination/ Storage | Knows the proper post exposure handling of the respirator selected: <ul style="list-style-type: none"> • Cartridge Disposal • Facepiece and equipment decontamination • Facepiece disinfection • Storage | | | |
| 10. | Documentation | Demonstrates how to correctly obtain and fill out SBMS <i>Respirator Selection Form</i> . | | | |

Practical Skill Evaluation: Demonstration of Knowledge by Evaluation of a Case Study

| | Criteria | Qualifying Performance Standard | Unsat. | Recov. | Satisf. |
|-----|---|--|--------|--------|---------|
| 11. | Evaluation of a Hypothetical Exposure Scenario | Scenario Title: _____ First Score: _____ Retest Score: _____ | | | |

I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

| | |
|----------------------|-------|
| Candidate Signature: | Date: |
|----------------------|-------|

I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

| | |
|----------------------|-------|
| Evaluator Signature: | Date: |
|----------------------|-------|